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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/905,157	07/12/2001	Nathan S. Lewis	CIT1270-1	2732

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EXAMINER

KIELIN, ERIK J

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 03/04/2003

13

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/905,157

Applicant(s)

LEWIS ET AL.

Examiner

Erik Kielin

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 February 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5, 9-17 and 21-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 9-17 and 21-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-5, 9-11, and 13-17, 21, 25-30 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,429,708 (**Linford et al.**).

Regarding claims 1 and 13, **Linford** discloses an electrical structure comprising a silicon-containing material **12** having a surface **40**; and an organic monolayer **45** chemically bonded to the surface **40** of the silicon-containing material **12**, wherein an electrical property of the electrical structure is seen to inherently be significantly changed compared to a same structure without the organic layer, as admitted by Applicant will happen and as indicated by **Linford** (col. 1, 21-31; paragraph bridging cols. 8-9).

Regarding claims 2, 3, 14 and 15, as just noted the organic layer inherently affects the electrical property of the silicon-containing material, wherein any of the electrical properties is selected from a group consisting of surface recombination velocity, carrier lifetime, electronic efficiency, voltage, contact resistance, and resistance of a doped region. Evidence is the admission of Applicant and as indicated by **Linford**, as noted.

Regarding claim 4, the organic layer is a hydrocarbon (Fig. 4; col. 4, line 44 to col. 5, line 13).

Regarding claims 5, and 17, the organic layer is a polymer (Fig. 12; col. 5, lines 37-45).

Art Unit: 2813

Regarding claims 9-11 and 28-30, the silicon-containing material is monocrystalline, polycrystalline, amorphous, or porous (col. 1, lines 17-21).

Regarding claim 16, the organic layer is a monolayer (Figs. 3-12).

Regarding claims 21, the organic layer is formed by activating the surface of the silicon-containing material; and reacting the activated surface with a chemical, wherein during the reaction, a hydrocarbon group becomes chemically bonded to the silicon-containing material. (See col. 2, lines 6-45.)

Regarding claim 25, the hydrocarbon is an allyl, called "alkenyl" and structurally described as " $-C(R)=CH(R')$ " for example, in **Linford** (col. 5, lines 5-34).

Regarding claim 26, a polymer is formed by reaction with the surface-bound allyl group (col. 5, lines 37-46; paragraph bridging cols. 5 and 6).

Regarding claim 27, the hydrocarbon group is an alkoxide group (col. 4, lines 44-49; Fig. 5).

3. Claims 13, 21-24 are rejected under 35 U.S.C. 102(b) as being anticipated by JP 6-84853 A (**Tsukune et al.**).

Regarding claims 13 and 21-24, **Tsukune** discloses activating a silicon-containing material (silicon, Si) by halogenating with HF (F is the halogen) and then reacting the activated silicon-containing material surface with a chemical (methanol) to chemically bond a monolayer of methyl groups to the silicon in the surface which has only 1 carbon atom. (See paragraphs [0010]-[0012], translation provided.) **Tsukune** teaches that the electrical property of, at least,

Art Unit: 2813

voltage in the silicon is improved because defects are prevented in the contact between the tungsten or silicon deposited on the silicon-containing material (wafer) (paragraph [0018]).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Linford** in view of US 3,961,353 (**Aboaf et al.**).

The prior art of **Linford**, as explained above, discloses each of the claimed features except for indicating the porosity to have an upper limit of 30%.

Aboaf teaches a semiconductor device having a porous layer of silicon 12, wherein the silicon has a porosity of 15%. The silicon layer has a protective layer 15 formed there over to prevent oxidation in subsequent processes. (See col. 2, lines 41-61; col. 3, lines 3-13.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to limit the porosity to no greater than 15% in order to form the device in **Aboaf**. Furthermore, the degree of porosity at no greater than 30% is an obvious matter of design choice and of routine optimization, depending upon the particular application of the porous silicon, at the suggestion of **Linford** to use porous silicon --especially since Applicant has provided no reason why the percentage porosity of the silicon bears any criticality to the formation of the organic layer.

Art Unit: 2813

Response to Arguments

6. Applicant's arguments filed 19 February 2003 have been fully considered but they are not persuasive.

Applicant argues on page 2, first paragraph of the Response (Paper No. 12, filed 26 February 2003),

"The rejection of claims 1-5, 9-11, 13-17, 21, and 25-30 under 35 U.S.C. § 102(b) as allegedly being anticipated by Linford, et. al. (U.S. Patent No. 5,429,708) is respectfully traversed. Applicants' invention distinguishes over Linford by requiring an electrical structure comprising a silicon-containing material having a surface, and an organic layer chemically bonded to the surface of the silicon-containing material, wherein an electrical property of the electrical structure is significantly changed compared to a same structure without the organic layer. Linford does not describe such an electrical structure, indeed, Linford is silent with respect to electrical structures. Instead, Linford merely describes a method for attaching molecular moieties to a silicon surface. In contrast, the present invention, as defined for example, by claim 1, provides far more than merely a silicon surface with molecular moieties attached thereto.

First, Examiner respectfully disagrees that Linford fails to disclose an electrical structure. Rather the first paragraph of col. 1, under the section entitled "BACKGROUND ART" is replete with numerous electrical structures --e.g. "electronic devices, solar cells, chemical sensors, micro-mechanical devices, and electrochemical cells" (Linford col. 1, lines 15-17) using various forms of silicon in their manufacture-- to which the Linford invention is drawn.

Second, Examiner respectfully disagrees that Linford fails to teach that "an electrical property of the electrical structure is significantly changed compared to a same structure without the organic layer. Linford states in col. 1, lines 14-17, "

"Silicon materials are used in a wide variety of technical **applications**, including for example, **electronic devices**, **solar cells**, **chemical sensors**, micro-mechanical devices, and **electrochemical** cells. These and other applications employ different forms of silicon materials, such as single

Art Unit: 2813

crystal or polycrystalline silicon, amorphous silicon, silicon nanocrystals, porous silicon materials, or thin films of any of these forms of silicon. In many applications, it is useful to be able to modify the chemical or physical properties of the silicon surface according to the function it is to perform.” (Emphasis added.)

In addition Linford states in the sentence bridging cols. 1-2,

“There is thus a need for new methods of chemically and physically **modifying silicon surfaces by forming molecular layers** of any desired size and molecular consistency, both **to improve the performance** of silicon in **present applications** and to develop new applications of silicon materials.” (Emphasis added.)

Accordingly, Linford explicitly teaches that modifying the silicon surfaces for “present applications” which include the electrical structures formed in silicon, as noted above by Linford, which are modified “to improve [their] performance.”

For this reason, Applicant’s argument is not found persuasive.

Applicant further argues,

“In addition, Applicants respectfully disagree with the Examiner's assertion that Linford inherently describes Applicants' claim element that an electrical property of an electrical structure containing a silicon surface modified with an organic layer is significantly changed compared to a same structure without an organic layer. In order to support an anticipation rejection based on inherency, the burden initially lies with the Examiner to demonstrate that the allegedly inherent feature necessarily flows from Linford's disclosure. It is respectfully submitted that the Examiner has not met this burden for the following reasons.

“Linford does not describe any type of electrical structure whatsoever. Linford merely describes a method for modifying a silicon surface. Linford clearly does not correlate the modification with any significant change in an electrical property of an electrical structure containing a modified silicon surface. Instead, Linford merely provides a passing reference to various general uses for silicon surfaces (see col. 1, lines 21-31 and col. 8, line 53 to col. 9, line 2). Linford's disclosure is clearly insufficient to demonstrate that the allegedly inherent feature of Applicants' invention will inevitably result from the modification of a

Art Unit: 2813

silicon surface as set forth therein. Instead, the Examiner uses the present specification in efforts to make a correlation and thereby support the assertion that Linford inherently anticipates the present invention (see Office Action mailed October 15, 2002, page 3, lines 20-21). Such hindsight use of Applicants' specification is respectfully submitted to be improper. Thus, it is respectfully submitted that the anticipation rejection based on inherency is not properly applied. Accordingly, reconsideration and withdrawal of the rejection of claims 1-5, 9-11, 13-17, 21, and 25-30 under 35 U.S.C. § 102(b) are respectfully requested.

In addition to explicitly indicating that the electrical property would be changed "to improve the performance," the Linford modified surface necessarily will change the electrical property of the electrical structure because the surface modifications disclosed in Linford are the equivalent to those disclosed in the instant specification and presently claimed. Note that Applicant provides no argument that the surface modification is somehow different. Applicant only argues that Applicant observed a change in the electrical property. Note, the claiming of a new use, new function or unknown property which is inherently present in the prior art does not necessarily make the claim patentable. See *In re Best*, 562 F.2d 1252, 1254, 195 USPQ 430, 433 (CCPA 1977). In the instant case, Applicant is not even claiming a "new" property or function, but is instead claiming a *known* property or function of such chemically bonded organic molecules to a silicon surface. Linford states that the performance is improved in electrical applications by the surface modification, as noted above. Accordingly, the electrical properties are necessarily changed of an electrical structure.

Additional basis for inherency is that Applicant admits that a surface modified to chemically bond organic molecules will necessarily change the electrical properties. (See, for example, instant specification paragraph [0012], first sentence.)

Art Unit: 2813

Moreover, Applicant states, above, "Linford does not describe any type of electrical structure whatsoever." But Linford describes that his surface modification is for solar cells, electronic devices, chemical sensors, electrochemical cells, each of which is an electrical structure. Accordingly, Applicant's allegation that Linford "merely describes a method for modifying a silicon surface" ignores the express teaching in Linford that the surface modification is "to improve the performance" of such electrical structures disclosed in Linford.

Applicant alleges that Examiner is using hindsight reasoning in applying inherency. Examiner respectfully disagrees. Instead, Examiner has used Applicant's specification as additional support that the equivalent structures in Linford will necessarily serve the equivalent function. This is not improper because it is merely the pointing out of Applicant's admission on the record that a given structure will necessarily provide a given function. Since Linford teaches the equivalent structure, it must, by Applicant's admission, perform the equivalent function.

Finally it is noted that MPEP 2145 states that "argument does not replace evidence where evidence is necessary." Applicant has not provided evidence that the Linford surface modification does not change the electrical property of the electrical structures disclosed therein. In light of the evidence of record that indicates that the electrical property would change, Applicant's arguments are insufficient, in accordance with MPEP 2145.

Applicant argues regarding the Tsukune reference,

"The rejection of claims 13 and 21-24 under 35 U.S.C. § 102(b) as allegedly being anticipated by Tsukune, et. al. (JP 6-84853 A) is respectfully traversed. Applicants' invention, as defined for example, by claim 13, distinguishes over Tsukune by requiring a process for forming an electrical device comprising providing a silicon-containing material having a surface, and forming an organic layer chemically bonded to the

Art Unit: 2813

surface of the silicon-containing material, wherein an electrical property of the electrical device is significantly different compared to a same device if the organic layer is not formed. Tsukune does not describe such a process. Like Linford, Tsukune merely describes a process for attaching methyl groups to a silicon surface, and only makes a passing reference to electrical properties. In contrast to the process defined by present claim 13, Tsukune does not require that an electrical property of a device containing a modified silicon surface be significantly changed compared to a device containing an unmodified silicon surface.

"In addition, Applicants respectfully disagree with the Examiner's assertion that Tsukune's silicon surface provides a change in voltage compared to an unmodified silicon surface. Upon review of the English translation of Tsukune which accompanied the Office Action, Applicants find no reference to voltage whatsoever, and in particular, no reference to voltage with respect to the methylated silicon surfaces described therein. Thus, it is respectfully submitted that Tsukune does not describe each and every element required by present claim 13. Accordingly, reconsideration and withdrawal of the rejection of claims 13 and 21-24 under 35 U.S.C. § 102(b) are respectfully requested.

Examiner respectfully disagrees that Tsukune fails to teach or suggest each of the features of the rejected claims, as noted above in the rejection. Applicant's argument is, again, based upon the premise that the Tsukune reference does not "state" that an electrical property would be changed. Examiner respectfully disagrees. First, the title of Tsukune is "Method of Forming a Semiconductor Device." Accordingly an electrical structure is disclosed. In the Abstract, Tsukune states that "the reliability of a semiconductor device can be enhanced." In other words the chemical bonded organic molecules result in the enhanced reliability (i.e. electrical properties) of the semiconductor device. Again, Tsukune expressly teaches that the electrical properties are changed.

Additionally, the arguments applied above regarding the inherency of the chemically bonded organic molecules necessarily modifying an electrical property structure are applied

Art Unit: 2813

equally herein because Tsukune teaches the equivalent chemically bonded molecule which must therefore perform the same function.

Examiner also respectfully disagrees that there exists no change in surface voltage given the teaching in Tsukune which indicates that surface defects are prevented in the silicon at the interface between the surface and a subsequently deposited tungsten or silicon layer. The surface voltage is indeed different because the defects are absent. Note that "in considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom." *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968) See also *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976). The above is an implicit teaching.

Applicant argues,

"The rejection of claim 12 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Linford in view of Aboaf, et. al. (U.S. Patent No. 3,361,353) is respectfully traversed. Applicants' invention, as defined by claim 12, distinguishes over Linford by requiring an electrical structure comprising a silicon-containing material having a surface, and an organic layer chemically bonded to the surface of the silicon containing material, wherein an electrical property of the electrical structure is significantly changed compared to a same structure without the organic layer, and wherein a portion of the silicon-containing material immediately adjacent to the organic layer has a porosity no greater than approximately 30 percent. Linford does not describe such an electrical structure. Instead, Linford merely describes a method for attaching molecular moieties to a silicon surface. In contrast, the present invention provides far more than merely a silicon surface with molecular moieties attached thereto. In addition, as acknowledged by the Examiner, Linford does not describe silicon-containing material having a porosity no greater than 30 %. Reliance on Aboaf fails to cure the deficiencies of Linford Like Linford, Aboaf does not describe an electrical structure comprising a silicon-

Art Unit: 2813

containing material having a surface, and an organic layer chemically bonded to the surface of the silicon-containing material, wherein an electrical property of the electrical structure is significantly changed compared to a same structure without the organic layer. Instead, Aboaf merely describes methods for producing semiconductor devices having a porous layer of silicon. Thus, neither Linford nor Aboaf, alone or in combination, disclose the electrical structures required by the present invention.

Applicant's arguments are again based upon the assertion that Linford fails to teach the modification to the electrical properties. All of the responses to Applicant's arguments above regarding Linford are applied here in their entirety. Aboaf was applied for the reasons indicating in the rejection of the claims above, which is not addressed by Applicant.

Applicant further argues,

"Moreover, it is respectfully submitted that there is no motivation to combine Linford with Aboaf absent the teachings of the present invention. Indeed, Linford is silent with respect to porosity of a silicon layer. Thus, the motivation to combine is clearly provided by Applicants' specification. Such use of Applicants' specification is respectfully submitted to be improper. Accordingly, reconsideration and withdrawal of the rejection of claim 12 under 35 U.S.C. § 103(a) are respectfully requested.

Examiner respectfully disagrees that Linford is silent to the porosity of the silicon.

Linford states in col. 1, lines 17-21,

These and other applications employ different forms of silicon materials, such as single crystal or polycrystalline silicon, amorphous silicon, silicon nanocrystals, **porous silicon** materials, or thin films of any of these forms of silicon. (Emphasis added.)

Indeed, Linford expressly addresses porosity of silicon.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the

Art Unit: 2813

teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

In this case, the suggestion to combine the references is as noted above in the rejection:

“It would have been obvious for one of ordinary skill in the art, at the time of the invention to limit the porosity to no greater than 15% in order to form the device in **Aboaf**.”

Inasmuch as Linford is drawn to the modification of any type of silicon including porous silicon to form any electrical device, such as the one in Aboaf, one of ordinary skill would be especially motivated to follow the teachings in Aboaf to limit the porosity for that type of electrical structure, as well as to provide the surface modification disclosed in Linford in order “to improve the performance of silicon” as taught in Linford.

For at least these reasons, Applicant’s arguments are not found persuasive.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 4,960,722 (**Ogawa**) and US 5,304,583 (**Ogawa**) each teach chemically bonding an organic molecule to the surface of silicon to change the electrical properties.

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

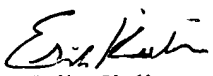
Art Unit: 2813

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Erik Kielin
March 1, 2003